

HIGH INTENSITY COMBUSTION

=> *for Efficient Burn Out*

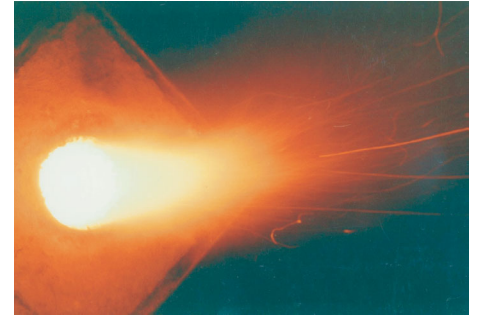
Advantages

- More compact combustion chambers;
- Higher average reactivity
- More complete burn-out
- Better flame stabilization and control
- More versatile for afterburner NOX control

Combustion Outcomes

- Particles heating rates $\sim 10^6$ °C/sec [standard: $10^4 - 10^5$]
- Combustion Intensities $\sim 10^6$ Btu / cu.ft.hr [std. $10^4 - 10^5$]
- Volatiles release and combustion time ~ 10 msec [std. 0.1 s]
- Combustion time $\sim 1/10^{\text{th}}$ sec [std. 1 sec (std. Grind)]

Scale of Current Studies: up to 5×10^4 Btu / hr



High Intensity Pulverized Coal Flame burning smoke free into the open

Farzan, H. and Essenhigh, R.H.: *High Intensity Combustion of Coal*. 19th Symp. (Internat.) on Combust, pp. 1105-1111, Combust. Inst., Pittsburgh 1982

Klimesh, H.E. and Essenhigh, R.H.: *Determination of Char Reactivity from Measurement of PSD in High Intensity Pulverized Coal Flames*; Poster paper: 28th Symp. (Internat.) on Comb., Edinburgh, 2000

CWF COMBUSTION

for Slagging, Fouling, and Particulate Control:

Alternative to standard pc firing of conventional boilers

Process

- Deep cleaning to reduce to $< 1\%$ mineral matter, separating (higher density) inorganic from (lower density) organic, and formulated as a slurry
- Transportation, storage, and firing simulating a "heavy fuel oil"
- Atomization possible by (natural) gas/air mixture

Advantages:

- Reduction/removal of mineral matter that turns to ash & slag on firing
- Reduction/elimination of slagging and fouling, with reduced operational costs;
- Reduction of sulfur content by 1/3 to 2/3 (depending on the coal);
- Gas atomization provides more flexibility in NOX control;
- Low/zero particulates allows for direct firing of gas turbines;
- Cleaner return of removed mineral matter (soil) in disposal.

Obloza, Hammond, T. & Essenhigh: *Control of SOX Emissions by Sorbent-Loaded Coal-Water Fuel Mixtures*. 3rd. Internat. Conf. on Proc. and Utilizn of High-Sulfur Coals, Ames, Iowa, Nov. 1989

ANOTHER OPTION:

High intensity combustion of CWF: targeted for direct firing of gas turbines

Liu, Zghoul, Li, Tan, Lockwood, & Essenhigh *High Intensity Combustion of Coal with Water Injection*; Combustion & Flame, 63, 49-57 (1986)

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